

General Husbandry and Captive Propagation of Bearded Dragons, *Pogona vitticeps*

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ABSTRACT: As bearded dragons, *Pogona vitticeps*, become increasingly popular pets, reptile veterinarians must be prepared to guide owners toward proper husbandry, diet, and reproduction. This paper outlines appropriate housing, substrate, and lighting necessary for these lizards to thrive. It also outlines the necessary food and water requirements. For clients who intend to breed their dragons, guidance on determining the sex of the dragons and establishing the ideal breeding environment is given. Notes on egg incubation are also provided.

KEY WORDS: bearded dragons, *Pogona vitticeps*, husbandry, diet, reproduction, egg incubation

INTRODUCTION

The inland bearded dragon, *Pogona vitticeps*, is quickly replacing the green iguana, *Iguana iguana*, as the most popular pet lizard in the United States (Figures 1 and 2). The bearded dragon is a more favorable pet because it is generally tame, easy to handle, is moderate in size (total length of 46 - 61 cm, 18 - 24 inches) compared with the green iguana, and is relatively easy to breed. Reptile clinicians must become familiar with the general husbandry and captive breeding of these lizards as they increase in popularity.

Inland bearded dragons are large diurnal agamid lizards native to central Australia. The first bearded dragons imported into the United States were captive-bred dragons from Germany in the early 1980s. These lizards are now readily being bred in the United States, and many color morphs are becoming available. de Vosjoli and Mailloux (1996) describe some of the color morphs that are being readily produced, which include red, yellow, gold, pastel and Sandfire™ (Sandfire Dragon Ranch, Vista, CA) varieties. There is a larger size morph known as the German giant that is also being readily produced in captivity.

As with other lizards maintained in captivity, providing the proper husbandry for the bearded dragon is critical for success.

HUSBANDRY

Adult housing - Bearded dragons are active lizards that require a large enclosure to thrive (Figure 3). They can be housed singly, in sexual pairs or in groups with one male and two or more females. Two males and multiple females may be housed as a group if the cage is very large with multiple hid-



Figure 2. Adult male bearded dragon, *Pogona vitticeps*.

ing places and basking sites. Some fighting between males may occur even in the biggest of enclosures. de Vosjoli and Mailloux (1993) recommend a minimum floor space of eight square feet for up to three adult dragons with another four square feet of floor space for each additional dragon. The minimum size terrarium for a single adult bearded dragon would be 183 cm (72 inches) long by 41 cm (16 inches) wide by 43 cm (17 inches) high.

Outdoor enclosures can also be used. These allow the lizards exposure to natural sunlight. These enclosures must be secure enough to keep the lizards in and predators out. Ample shade and fresh water should be provided, and water drainage is important to avoid the enclosure filling with water during heavy rain. de Vosjoli and Mailloux (1993) provide an excellent review of appropriate indoor and outdoor enclosures for bearded dragons.

Juvenile housing - Juvenile bearded dragons can be raised in simple cages such as aquariums or plastic tubs. It is best to have long enclosures (e.g. minimum 10 - 20 gallon aquarium) to allow an adequate temperature gradient from the heat lamp, and low enclosures to allow maximum benefit of ultra-violet lighting. If possible, it is best to individually house



Figure 1. Bearded dragons, *Pogona vitticeps*, can make wonderful pets that owners can truly bond with.



Figure 3. Large spacious enclosures with climbing areas work best for adult bearded dragons, *Pogona vitticeps*.

These substrates provide ease of maintenance and the ability to observe the feces and urates. If these substrates are inadvertently ingested they will move through the gastrointestinal system. Additionally these substrates make management of gastrointestinal parasites less labor intensive. de Vosjoli and Mailloux (1993) recommend play sand (no finer than #30) or decomposed granite. The author has seen some problems with



Figure 4. Juvenile bearded dragons, *Pogona vitticeps*. Overcrowding juvenile bearded dragons may result in stress with subordinate lizards failing to thrive.



Figure 5. It is best to house young dragons individually but, if not possible, small groups can be maintained provided they are similar in size and food is abundant. Photo courtesy of Bill Love.

young bearded dragons. If not possible, young dragons can be housed in small groups of four to five but they all must be similar in size and plenty of food must be available. Often smaller dragons must be separated if they are not competing well with siblings (Figures 4 and 5).

Substrate and furniture - This author prefers a substrate of paper pulp material or newspaper.

gastrointestinal impaction associated with sand and other particulate bedding so use with caution.

Juvenile bearded dragons can successfully be raised with newspaper or no substrate on the bottom of the enclosure (Figure 6). This keeps both the young dragons and their small prey items visible to the caretaker and provides ease of maintenance. Regardless of the substrate used it should be kept clean and relatively dry.

Bearded dragons are semi-arboreal lizards and they should be provided with ample climbing objects, including large branches, driftwood pieces, cork bark and/or large rocks. If several lizards are housed together cage furniture should be utilized to allow several basking sites and several hide areas.

Heating and Lighting - Proper lighting is critical for successful maintenance of the diurnal bearded dragon. A basking light (incandescent white or clear bulb to provide bright light) should be placed at one end of the enclosure to provide radiant heat and a temperature gradient within the enclosure. de Vosjoli and Mailloux (1993) recommend an ambient daytime temperature in the cage of 27 - 29°C (80 - 85°F) with a basking site temperature range between 32 - 35°C (90 - 95°F), and a nighttime temperature drop to 21°C (70°F). Multiple sites for basking under the bulb should be available to provide gradients of temperature within the basking site itself. A dark flat rock under the basking light can provide additional ventral heat, which may aid in digestion. A ventral heat source such as an under-the-cage heating pad or a heat strip, a ceramic heat bulb, or red incandescent bulb may be provided at night. Additional nighttime heat sources may not be necessary as dragons prefer cooler temperatures at night for sleeping.

Ultraviolet light appears to be important for bearded dragons to metabolize calcium. Natural sunlight is the best source of ultraviolet light B (UVB). Exposing bearded dragons to natural sunlight (not filtered by glass) for 30 minutes to one hour several times a week is extremely valuable, (Figure 3) especially for young, growing dragons. Precautions must be taken to prevent overheating when providing exposure to natural sunlight. Adequate shade must always be available.

If natural sunlight is not available, dragons should have full-spectrum lighting that provides some UVB. Commercially available fluorescent bulbs should be selected specifically for their ability to provide UVB. It is important that the dragons are within 12 inches of the bulb and no glass or Plexiglas is between the lizard and the bulb. These lights should be on a cycle of 12 - 14 hours in the summer and 10 - 12 hours in the winter. The bulbs should also be changed every six to eight months since the UVB production diminishes even though the bulbs still produce light.

A new light bulb has recently become available that looks promising for use with bearded dragons. The bulb, called Active UVHeat™ (Active UVHeat, Santa Barbara, CA) may provide ultraviolet (UVB and UVA) lighting and infrared heat combined in an incandescent bulb.

DIET

The bearded dragon is omnivorous, but field studies show that adult dragons are primarily herbivores consuming approximately 90% vegetable matter. Juveniles are truly omnivorous feeding on 50% plant material and 50% animal matter (MacMillen, *et al*, 1989). It is best to try to simulate the diet of dragons in the wild.

Adults - Dark green, leafy vegetables should be offered daily. Excellent choices of greens include leaf lettuce such as romaine, red leaf, green leaf, and Boston. Also, collard greens, kale, endive, spinach, parsley, bok choy, and broccoli

leaves and florets should be offered. Other bulk vegetables such as carrots, squash, peas and beans can be offered in more limited amounts. The author prefers to chop or shred the greens and place them in a bowl or plate and (Figure 5) spray the entire "salad" with water prior to feeding. A calcium supplement can be dusted on top of the salad. Insects can be offered to adults two to three times weekly. Insects should be well fed prior with an insect gut-loading diet or a complete animal ration such as psittacine pellets, rodent chow, or dry dog food. Insects can then be dusted with a calcium and vitamin D₃ supplement two times weekly. Every other week crickets can be dusted with a multivitamin.

Crickets should be the primary insect fed to dragons, but mealworms, giant mealworms, and wax moth larvae may also be offered in more limited amounts. Offering insects in a large deep bowl provides a feeding station to help the dragons locate prey items. Occasionally, adult dragons can be offered pinky or fuzzy mice (Figure 7). Commercial bearded dragon diets are also available and may be used as part of the diet. These diets should not make up more than 50% of the diet, and if they are accepted readily, other vitamin and mineral supplementation should be reduced to avoid over supplement-



Figure 6. A simple set up for juvenile bearded dragons, *Pogona vitticeps*, often works well. Newspaper as a substrate and a low flat water pan for lizards to climb into if desired.

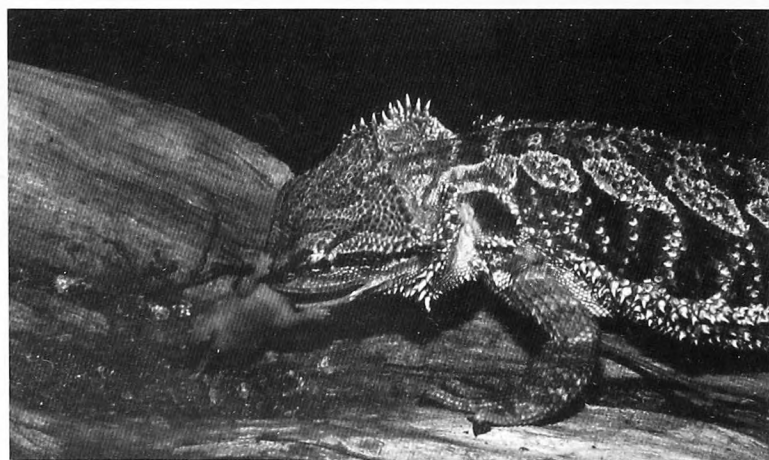


Figure 7. Bearded dragons, *Pogona vitticeps*, are omnivorous. In addition to fortified vegetables, insects and commercial diets, dragons can be occasionally offered pinky or fuzzy mice. Photo courtesy of Bill Love.

tation of the diet. Commercial pelleted diets should be offered moistened with water to provide additional fluid for the dragons.

Juveniles - Juveniles should be offered greens and vegetables (as described above for adults) daily and insects, such as appropriately-sized crickets (no larger than the width of the dragon's head), twice daily. Crickets should be dusted with a calcium/vitamin D₃ supplement three to four times weekly and a multivitamin once weekly. Do not place too many insects at a time in the enclosure with juvenile dragons as this can increase stress. Always provide food for the crickets in the cage so they don't feed on the baby dragons. Insects can also be placed in a deep bowl or dish that makes it difficult to escape. Providing a feeding station such as this makes it easier for the young dragons to find their food and helps owners to monitor eating. Juvenile commercial bearded dragon diets (moistened with water) can be fed as part of the diet (up to 50%). If a good portion of the young bearded dragon's diet is a commercial diet, insects should be dusted less often to avoid over supplementation.

Water - Water should be fresh and clean and always available to adult bearded dragons. It is best to use a large dish or bowl that they can easily climb into. Juveniles should be offered water in very shallow containers to allow them to sit in the water or run through it (Figure 6). Spraying or misting the environment (but not the dragons themselves) once daily is recommended, especially for juveniles. Many dragons will learn to drink from a rodent water bottle or sports water bottle by dripping water on the nose. Additionally, dragons can be soaked in a warm water bath to encourage drinking.

REPRODUCTION

Sexual Morphology - Sexual dimorphism is not readily apparent in juvenile or subadult bearded dragons, and they can be difficult to sex. If several juvenile dragons are present it may be possible to determine their sex by comparing the tail base. Lizards with a thicker, flatter tail base that doesn't taper as quickly from the vent, may be males.

At about five to six months of age or at 25 - 30 cm. (10 - 12 inches) total length, bearded dragons may be sexed by placing the lizard in a normal ventral recumbency position and lifting the tail dorsally over the back of the lizard. If it is a male, the hemipenes will be noted as two lumps located just caudal to the vent at the tail base. Again it is easier to use this technique if several dragons are available for comparison. Another technique used to sex subadult dragons is eversion of the hemipenes. One person restrains the lizard in dorsal recumbency and another person places a forefinger and a thumb on each side of the cloaca. The hemipenis is everted with firm digital pressure (down and forward) just lateral and caudal to the cloaca, while simultaneously pulling the cloaca open (Figures 8 and 9). No structures will evert in females. Use caution to avoid injuring the spine by applying excessive pressure.

At sexual maturity (as early as five to six months to 15 - 16 months of age depending on growth rate and size) there are several morphological differences that may become evident to help sex bearded dragons:

-Males will have a proportionally wider head than females and are larger than females.



Figure 8. Sometimes a hemipene can be gently but firmly “popped out” to identify the sex. Note the hemipenal plug which is a cast of the hemipenis made up of dried skin, sperm and secretions. This male bearded dragon, *Pogona vitticeps*, had a limb amputated due to osteomyelitis.



Figure 9. Hemipenal plugs (casts) removed from each hemipene of an adult male bearded dragon, *Pogona vitticeps*.

-Males will have larger femoral and preanal pores than females.

-Males tend to have a darker beard than females, and the darkness extends all the way to the tip of the mandible.

-Males may have a larger cloacal opening than females. Pulling back on the skin around the vent exposes the cloaca. The male cloacal opening is usually dramatically wider than the female cloacal opening (de Vosjoli and Mailloux, 1993).

Behavioral sexing - There are some behavioral differences between male and female bearded dragons that may help to identify the sex of individuals. Male dragons' beards will be darker, and they may extend and display their beards as a sexual display towards females or as an aggressive display toward male dragons. Head bobbing and fighting with other males and attempts to copulate a female are all consistent behaviors of a male bearded dragon.

When mature, female dragons will arm wave (one of the front legs is raised off the ground and is waved in a slow arc) toward a male during the breeding season or during copulation as a subordinate or receptive display. Juvenile bearded dragons of both sexes may also arm wave as a social interaction. Adult males arm wave less often and generally in response to a larger dominant male (de Vosjoli and Mailloux, 1993).

Breeding - As with other reptiles it is important that bearded dragons are in good health and body condition prior to the initiation of breeding. Single pairs of bearded dragons may be housed together for breeding or one male may be housed with several females. If the enclosure is large enough (minimum 8 - 12 square feet) two males may be housed together with a large group of females. However, fighting may occur between the males, so they should be closely monitored. Housing two

males together with a group of females may actually increase breeding activity of the males by increasing competition between them. This will also help to ensure that females that are receptive in the group will be bred, whether it be by the dominant or subordinate male (de Vosjoli and Mailloux, 1993).

Prebreeding - A prebreeding cool-down period that involves reducing heat and light cycle is recommended by de Vosjoli and Mailloux (1993). They've had excellent success by initiating this cooling cycle in early December and maintaining it through mid February. During this period, the light cycle is reduced to 10 hours of daylight and 14 hours of darkness. Concurrently, they recommend reducing the heat to basking temperatures of 24 - 27°C (75 - 80°F) with a night-time temperature drop to approximately 16°C (60°F).

Dragons may also initiate their own cooling cycle based on local climate conditions. For example in the northeast some dragons may begin a brumation period on their own in October or November.

Regardless of how the cooling period is initiated, dragons during this time will usually become less active, retreat and not feed well. Often, owners will mistake these inactive periods for an illness. It is important to observe dragons during this time for excessive weight loss or dehydration. Fresh water should always be available, and the dragons may be soaked for 15 to 20 minutes in luke-warm water weekly or every other week to make sure they are staying hydrated.

After mid-February, the light cycle returns to 14 hours of daylight and 10 hours of darkness, and a normal heat range is resumed. Feeding will usually resume and signs of breeding activity will begin within several weeks. de Vosjoli (1999) has found that when breeding bearded dragons indoors the length of the cooling cycles can vary between males and females and still result in breeding activity and fertile eggs. Males can be cycled for as little as two to four weeks whereas females may require up to 14 weeks.

Breeding Behavior and Copulation - If two males are housed together intense fighting and aggressive displaying will begin after this cooling period to establish dominance. Females may arm wave, display, and be receptive to males. Males will head-bob and chase females. Typically males will bite and carry females around by the skin on the back of the



Figure 10. Female bearded dragon, *Pogona vitticeps*, with an excavated clutch of recently laid eggs. Note the entrance to a starter burrow. Photo courtesy of Phillipe de Vosjoli.



Figure 11. Hatchling bearded dragon, *Pogona vitticeps*.



Figure 12. Hatchling bearded dragon, *Pogona vitticeps*.



Figure 13. Hatchling bearded dragon, *Pogona vitticeps*. Note that the yolk sac is fully resorbed indicating that this hatchling is ready to leave the incubator.

head and shoulders prior to or during copulation. Females should be observed for excessive trauma to skin in these areas.

Oviposition and fecundity - Female dragons that have been bred will begin to show abdominal enlargement and roundness with a loss of mass in other areas, including the pelvis

and limbs. Oviductal eggs may be seen pressing against the abdomen and/or may be easily palpated. These females will generally lay their eggs two to three weeks after being bred. Nesting behavior, such as restlessness in the enclosure and digging, may be observed.

A variety of nest sites may be acceptable to bearded dragons. de Vosjoli and Mailloux (1993) have had good success by dumping several buckets of freshly dug garden soil into the dragon's normal enclosure. They then pat down the soil to bind it together and then dig out several "starter" burrows to entice the females. They have found these starter burrows will tempt a female to finish the burrow and lay her eggs. They also recommend providing at least 12 inches of depth in the nest site to allow the dragons to bury themselves to the tip of the nose in the nesting tunnel when they back in to lay their eggs.

Females will generally cover their eggs after they have been laid and generally guard the site for a short period. Weis and Weis (1994) recommend a nesting area containing 12 inches of a damp sand, sand/peat mixture or moist mulch. The author has had success using these same substrates placed in large/deep plastic tub within the dragon's enclosure with easy access into the tub for gravid females. Once the eggs have been laid they should gently be removed from the nest, (Figure 10) maintained in their original orientation and gently placed into the incubation medium.

Clutch sizes may range from 6 to 40 eggs with an average of 15 to 25 (Pether, 1997). Female bearded dragons will generally lay three to five clutches of eggs spaced two to five weeks apart during the breeding season (Weis and Weis, 1994). de Vosjoli (1999) reports that, on average, females will produce three clutches of eggs in the first year of breeding and up to seven clutches in the second year. The number of clutches will begin to drop in third and subsequent seasons. Females are generally receptive to males immediately after oviposition. To increase fertility, females should be placed with an active cycling male. Females must be fed aggressively (with calcium supplementation increased) and monitored closely for body condition during this active and potentially productive breeding season. Assisting with feeding and watering by hand for several days after oviposition will help ensure that the females recover adequately.

Weis and Weis (1994) describe a common fertility problem when the dominant male or only male goes out of breeding cycle while the females in their group are still in their egg-laying cycle. They recommend having a back-up male that is concurrently cycling who can be used to breed females that



Figure 14. A normal stool of an adult bearded dragon, *Pogona vitticeps*. Note fecal and urate material. A ring of fluid around the stool is also common especially when feeding greens.

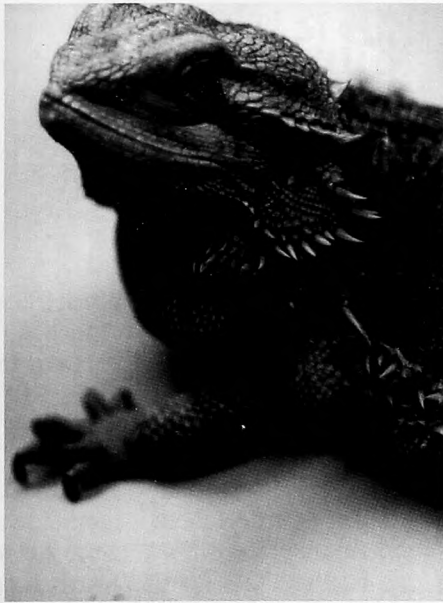


Figure 15. An obese adult female bearded dragon, *Pogona vitticeps*. Increasing the greens in the diet of adult bearded dragons may help to reduce over-conditioning.

are no longer being bred by males in an original group. This will help prevent too many infertile eggs. Active males are usually observed continuously courting and copulating with females.

Egg incubation - A variety of techniques may result in successful incubation of bearded dragon eggs. de Vosjoli and Mailloux (1993) recommend using coarse vermiculite at five parts vermiculite to four parts water by weight and incubating the eggs at a constant temperature of 29°C (84°F). Two thirds of the egg is buried in the vermiculite and a light misting of water can be

applied to the vermiculite around the eggs once weekly if they appear dry. Under these conditions the eggs will hatch in 55 to 75 days.

This author has had good success incubating bearded dragon eggs by placing the eggs (buried two thirds) in vermiculite (one part vermiculite to two parts water by weight) in a small plastic shoebox. A small number of air holes are poked in the container to allow some air exchange. The vermiculite should not be allowed to dry out, and small amounts of water may need to be added to the vermiculite to maintain the original

moisture content. The entire shoebox is then placed in an incubator that is maintained within a range of 29°C (84 - 85°F). Eggs will usually hatch within 50 to 70 days. (Figures 11, 12 and 13).

Eggs will generally hatch over a two to three day period but some eggs may hatch even a week after the first eggs hatch. The author leaves hatchlings in the incubator for one to two days after they leave the egg. Once hatchlings leave their shell, they may be placed in a separate sweater box poked with air holes and lined with moist paper towels and kept within the incubator for a day or so while the rest of the dragons hatch. Hatchlings should be examined to ensure yolk sacs have been properly absorbed before being removed from the incubator (Figure 13). See housing and feeding of juvenile dragons above for hatchling dragon husbandry.

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